DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITTING and COMPLIANCE DIVISION
MONTANA GROUND WATER POLLUTION CONTROL SYSTEM (MGWPCS)

Fact Sheet/Statement of Basis

Permittee:	G & B Construction and Development, LLC
Permit No.:	MTX000206
Receiving Water:	Class I Ground Water
Facility Information:	
Name	Frontier Village Estates Major Subdivision, Phases I & II
Location	SW 1/4 of Section 19, Township 11 North, Range 3 West in Lewis and Clark County, on the north side of John G. Mine Road, between Applegate Drive and Montana Avenue.
Facility Contact:	Chad Koehler/Developer 753 Nichole Street Helena, Montana 59601 Phone: (406)459-3100
Information:	
Number of Outfalls	Two (2) for the purpose of fee determination
Outfall – Type	001 – Treated domestic wastewater to a subsurface drainfield 002 – Treated domestic wastewater to a subsurface drainfield

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I. Permit Status

This statement of basis is for the issuance of a new wastewater discharge permit for Frontier Village Estates Major Subdivision Phases I & II (FVEMS) pursuant to the Montana Ground Water Pollution Control System (MGWPCS). The permittee, G & B Constuction and Development, LLC submitted a permit application (Form 1 and GW-1) on October 26, 2007 in accordance with ARM 17.30.1023 (3) and (4). All fees were received on November 21, 2007. The permittee has proposed a Level II wastewater treatment system [ARM 17.30.702(11)] and has requested a permit limit based on a 60% TN removal rate rather than the technology-based concentration limit 24 mg/L total nitrogen (TN).

A request for supplemental information [ARM 17.30.1023(5)] was made by the Department verbally in a meeting held on November 29, 2007. A written response was received by the Department on December 18, 2007. The MGWPCS application was determined to be complete [ARM 17.30.1024(1)] on December 18, 2007. This is a new source, as defined in ARM 17.30.703(18), and is therefore subject to the Montana Nondegradation Policy (75-5-303, MCA) and administrative rules (ARM 17.30.701, et seq.). FVEMS will be permitted by the Department under 75-5-402(1), MCA.

The Public Water Supply Division has reviewed and approved (October 18, 2007) the water supply system (EQ#08-1420) for Phase II of this subdivision. This proposed subdivision is also subject to review and approval under the Montana Sanitation in Subdivision Act. The applicant will submit plans and specifications to the Department's subdivision section for review in order to receive a Certificate of Subdivision Plat Approval.

II. Facility Information

A. General Description

The FVEMS will be approximately three miles north-northwest of the city of Helena in the Helena Valley. This proposed subdivision will be located on the north side of John G. Mine Road, between Applegate Drive and Montana Avenue. The subdivision will be built in two phases. Phase I will consist of 73 single family homes and Phase II will have 46 single family homes.

B. Wastewater Collection, Treatment, and Disposal

Two separate 8-inch diameter PVC gravity sanitary sewer collection systems will serve each phase of the development. Raw sewage collected from Phase I will be sent to two 25,000-gallon septic tanks arranged in series. The septic tanks will provide primary anaerobic treatment as well as removing floatable and settleable solids. Wastewater will gravity flow from the last septic tank into a 35,000-gallon recirculation tank. From the recirculation tank, the wastewater is pumped to a recirculating sand filter (RSF) where it receives Level II treatment. Based on a 4:1 split, 80% of the effluent from the RSF is routed back through the recirculation tank and the RSF, while 20% will gravity feed to a 4,500-gallon, drainfield-dose tank. The effluent will be metered through three totalizing turbine flow meters and pressure-dosed from the drainfield dose tank to one multiple-zone (6 zones, each 109 feet x 51 feet) subsurface drainfield that discharges to the ground water (see Attachment 1). A design summary for Phase I is provided in Table 1.

Table 1: Frontier Village Estates Major Subdivision - Design Information for Phase I

Construction Date: Proposed	Modification Date: NA
Design Population: 73 single-family lots	Estimated Population: 174
Design Flow, Average (gpd): 14,600	Design Flow, Peak (gpd): 21,900
Disinfection (Y/N): No	Type: NA
Disposal Method: Subsurface Drainfield	
Effluent Flow Meter(s): 3 Orenco FM200 totalizing turbine flow meters (proposed)	
Sludge Pumping and Hauling: Helena Septic Pumping Service	Solid Waste License No.: S-951
Sludge Disposal: City of Helena Wastewater Treatment Plant	Discharge Permit No.: MT0022641

The applicant has requested to discharge 14,600 gallons per day (gpd) from Phase I.

Raw sewage collected from Phase II will be sent to a 12,000-gallon septic tank first, followed by a 20,000-gallon septic tank. Wastewater will gravity flow from the last septic tank into a 22,000-gallon

recirculation tank. From the recirculation tank, the wastewater is pumped to a recirculating sand filter (RSF) where it receives Level II treatment. Based on a 4:1 split, 80% of the effluent from the RSF is routed back through the recirculation tank and the RSF, while 20% will gravity feed to a 4,000-gallon, drainfield-dose tank. The effluent will be metered through two totalizing turbine flow meters and pressure-dosed from the drainfield dose tank to one multiple-zone (4 zones, each 103 feet x 51 feet) subsurface drainfield that discharges to the ground water (see Attachment 2). A design summary for Phase II is provided in Table 2.

Table 2: Frontier Village Estates Major Subdivision - Design Information for Phase II

Construction Date: Proposed	Modification Date: NA
Design Population: 46 single-family lots	Estimated Population: 109
Design Flow, Average (gpd): 9,200	Design Flow, Peak (gpd): 13,800
Disinfection (Y/N): No	Type: NA
Disposal Method: Subsurface Drainfield	
Effluent Flow Meter(s): 2 Orenco FM200 totalizing turbine flow meters (proposed)	
Sludge Pumping and Hauling: Helena Septic Pumping Service	Solid Waste License No.: S-951
Sludge Disposal: City of Helena Wastewater Treatment Plant	Discharge Permit No.: MT0022641

The applicant has requested to discharge 9,200 gpd from Phase II.

As part of the general facility operations and maintenance plan, settled solids/sludge from the septic tanks, the recirculation tanks, and the RSF will be removed periodically as needed, no set maintenance schedule is proposed. The applicant proposes to remove sludge and dispose of it at the City of Helena Wastewater Treatment Plant (Permit No. MT0022641).

III. Description of the Discharge

A. Outfall Location

The proposed permit authorizes the permittee to discharge domestic wastewater from a RSF treatment system to a subsurface drainfield at Phase I (Outfall 001), and a from a separate RSF treatment system to a subsurface drainfield at Phase II (Outfall 002).

- Outfall 001 is located in the north-central portion of the proposed subdivision and will serve Phase I.
- Outfall 002 is located in the south-central portion of the proposed subdivision and will serve Phase II.

B. Effluent Characteristics

This is a proposed site and the permittee has collected no wastewater samples for analysis. The effluent that is discharged from a typical RSF system to a subsurface drainfield is expected to have

the following (see Table 3 in this Statement of Basis) average and/or range of chemical characteristics based on typical performance data compiled by USEPA (2002).

Table 3. Typical Effluent Characteristics for a Recirculating Sand Filter Wastewater Treatment System

Parameter, (units)	Average Value	Range	Reference
Biological Oxygen Demand (BOD), mg/L	6.3	3-10	USEPA (2002)
Total Suspended Solids (TSS), mg/L	6	3-9	USEPA (2002)
Total Kjeldahl Nitrogen (TKN), mg/L	3.6	1.1-7.9	USEPA (2002)
Total Nitrogen(1) (TN), mg/L	22.7	16-31.5	USEPA (2002)
Total Phosphorous (TP), mg/L	1.5	1-2	USEPA (2002), MDEQ Memo-Regensberger, 1998
E-Coli Bacteria, # of organisms/100ml	<1	10^1-10^4	USEPA (2002)

(1) Total Nitrogen = the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).

According to 75-5-301(5)(d)(iii), MCA, changes in nitrate (as N) in the ground water are considered to be nonsignificant when the predicted concentration of nitrate (as N) at the boundary of the ground water mixing zone does not exceed 7.5 mg/L from raw sewage discharged from a system using Level II treatment, as defined in the following rule. ARM 17.30.702(11) states that Level II treatment means, the wastewater treatment system removes at least 60% of the total nitrogen (TN) as measured from the raw sewage load to the system, or the system discharges a TN effluent concentration of 24 mg/L or less. A properly operated and maintained RSF is considered to provide Level II wastewater treatment.

C. Compliance History

This is a proposed facility and the Department has not conducted any inspections at the site.

IV. Site Characteristics

A. Soils

Soil survey data (NRCS, 2003) identify soils in the area of the proposed subdivision as Scravo Gravelly Loam. The Scravo Gravelly Loam is associated with 0 to 2 % slopes. These soils extend from the surface to at least 60 inches (5 feet) below the ground surface (bgs). Soil permeability increases from moderate to rapid with increasing depth. This is primarily due to the increasing content of gravelly sand with increasing depth in the soil profile.

On August 14, 2006, five test pits (TPs) were dug to a total depth of eight (8) feet in the vicinity of the proposed wastewater treatment and disposal site. Soils observed in the southern three TPs ("A, D, and E") associated with the proposed Phase II drainfield area are described as loam with less than 10% gravel from 0 to 4 inches below ground surface (bgs). In the two TPs ("B and C") excavated to the north in the proposed Phase I drainfield area, loam soil was identified from 0 to 6 inches bgs. The percolation rate of the loam-topsoil layer was reported at 0.5 inches per hour.

Loamy sand was described beneath the loam topsoil layer in all five TPs. The loamy sand contains greater than 75% gravel. The percolation rate in the loamy sand subsoil was reported at 0.6 inches per hour (Fladland, 2006).

B. Geology

FVEMS is located in the Helena Valley, which is an intermontane basin bounded by folded and fractured sedimentary, metamorphic, and igneous rocks of Precambrian to Cretaceous age. The valley-fill (approximately 6,000 feet) is primarily composed of a thick section of fine-grained Tertiary lacustrine ash and volcaniclastic sediments with localized lenses of gravel. Unconformably overlying these deposits is a thinner section of locally derived fine-to-coarse-grained Tertiary sediments. The Tertiary sediments grade into the Quaternary alluvium, which makes up the upper 100 feet of the valley-fill material (Briar, 1992).

C. Hydrogeology

The upper 100 feet of the valley-fill material is best described as, "a sequence of complexly stratified lenses of cobbles, gravel, and sand. Lateral discontinuity of the many fine-grained layers allows hydraulic interconnection of the coarse-grained water-yielding zones, which therefore function as one complex aquifer system" (Briar and Morrison, 1992). The subsurface drainfields for FVEMS will be constructed in the near-surface portion of this Quaternary valley-fill material.

Based on the depths to shallow ground water measured in all seven wells located onsite, the depth to ground water ranges from 32.08 feet below the top of the casing (TOC) in Well #7 (most easterly well onsite), to 49.75 feet below the TOC in Well #4 (in the northwest portion of the site). On May 15th, October 9th, and December 4, 2007, static water levels (SWLs) were measured in five to seven of the onsite wells. From this data, high SWLs occurred in early October 2007, and low SWLs were observed in May 2007. There has been 5.50 to 6.00 feet of ground water level fluctuation observed in the water levels in these wells from high water to low water periods.

The wide range in the depths to ground water may be due to the variable type of well completion methods used (e.g., open bottom, multiple zones of slotted pipe, and factory slotted/screened pipe). However, according to the USGS Report (Briar and Morrison, 1992) the unconfined water-bearing zones in the valley-fill/alluvium may be considered to be one complex aquifer system.

The Helena Valley Irrigation Canal is 1,800 to 2,300 feet northwest and hydraulically upgradient from the proposed drainfield areas (Outfalls 001 and 002, respectively). During the summer months when the canal is in use, it is generally considered to reflect characteristics of a losing stream. However, according to the SWLs and ground water quality data from the site, it appears neither the seasonal ground water level fluctuations, nor the irrigation canal usage has any direct effect on the ground water flow direction and the hydraulic gradient.

D. Hydrology

FVEMS is in the southeastern-most corner of the North Hills Temporary Controlled Groundwater Area. Due to public concern about a decline in ground water levels, this is an area that was

designated by the DNRC in 2002, to track new wells being installed, meter flows, sample the ground water quality for nitrate, and measure static water levels in the wells. The controlled area expired on October 11, 2006 and was reinstated until April 12, 2008.

As a requirement of the temporary controlled ground water area, two 24-hour shallow aquifer pump tests were conducted at FVEMS to demonstrate adequate water availability for the proposed individual residential wells within Phase II of the subdivision. Well #1 ("existing well") was drilled and completed on March 1, 2002. This well is located along the southeast subdivision property boundary. Well #1 was completed as an open-bottom well completion to a total depth of 100 feet bgs in clean sand and gravel. Well #1 was pumped at 110 gallons per minute (gpm) for approximately 24 hours. No change in slope in the time-drawdown plot was observed once the maximum drawdown was attained in the first few minutes of the test. Using the above pump test data in conjunction with the transmissivity (T) equation from Fetter ($T= 33.6\ [Q/h_o - h)]^{0.67}$), $T = 7{,}360\ ft^2/day$). An aquifer thickness of 20 feet was used to calculate the hydraulic conductivity (K). The K for Well #1 was calculated to be 368 ft/day.

The second aquifer pump test (pumping rate =100 gpm) was conducted at Well #2. This well was drilled and completed on July 24, 2006 to 100 feet bgs. The well was pumped at 100 gpm for the duration of the 24-hour test. The calculated T value using Fetter's equation (above) was 2,675 ft^2/day. The K was calculated at 268 ft/day using a 10-foot aquifer thickness. The average K value from these two 24-hour shallow aquifer tests is 318 ft/day.

In addition, aquifer pump test and recovery data were submitted from a 10-inch diameter fire supply well (Well #3) that was drilled to a total depth of 160 feet bgs in the shallow aquifer of the valley-fill sediments. Well #3 was pumped for 24 hours at 1,000 gpm. The average T (156,800 ft^2/day) was based on actual pumping well (Well #3) recovery data and recovery data from two observation wells (Well #2 and the "Trailer Well"). The average K value of 1,244 ft/day was calculated using the more conservative estimated aquifer thickness of 126 feet.

The average K value from the Well #3 pump test is most representative of the area associated with a low hydraulic gradient (I) of 0.0008 ft/ft (average, see paragraph below), which also coincides with the proposed locations for Outfalls 001 and 002 at FVEMS. In comparison, the Applegate Meadows Subdivision is located adjacent to FVEMS to the north (NW/4 of Section 19). A shallow aquifer pump test was conducted in association with this development. The K was calculated to be 615 ft/day, however the I for the site was 0.002 ft/ft.

Based on the onsite ground water elevations, the hydraulic gradient (I) is steepest (.0012 ft/ft) beneath the northwest one-third of the property; flattening (.0003 ft/ft) over the southeast two-thirds of the proposed development. The average hydraulic gradient across the site is 0.0008 ft/ft. The direction of ground water flow is S62°E, as determined from the three-point problem analysis submitted by the applicant.

The nearest downgradient surface water from Outfall 001 and 002 is Silver Creek. Silver Creek is approximately 10,324 feet southeast of the proposed Phase I drainfield area, and 9,650 feet southeast of the proposed Phase II drainfield area.

V. Receiving Water Characteristics

Effluent is discharged from the wastewater treatment facility (Phase I and Phase II) to the ground water. 75-5-305(2), MCA states, that the Board shall establish minimum requirements for the control and disposal of sewage from private and public buildings**.** Applicable water quality standards for individual parameters of concern are established according to the receiving ground water classification based on specific conductivity in umhos/cm or microSiemens/cm. The average specific conductivity value in the shallow ground water at FVEMS is 523 μmhos/cm. This value is based on three quarters (2007) of sampling data from Well #7 (see Table 5).

According to ARM 17.30.1006 (Classifications, Beneficial Uses and Specific Standards for Groundwaters), the receiving water for Outfall 001 and 002 is Class I ground water. Class I ground water has a specific conductivity of less than or equal to 1,000 μmhos/cm at 25 degrees Centigrade, as defined by ARM 17.30.1006(1). According to ARM 17.30.1006(1)(a), the quality of Class I ground water must be maintained so that these waters are suitable for public and private water supplies, culinary and food processing, irrigation, commercial and industrial purposes, drinking water for livestock and wildlife, with little or no treatment. Human health standards listed in DEQ Circular 7 (February 2006) apply to concentrations of dissolved substances in Class I ground water.

Montana's nondegradation policy (75-5-303, MCA) applies to any activity of man resulting in a new or increased source which may cause degradation [ARM 17.30.705(1)]. The applicant must demonstrate that existing uses of state waters and the level of water quality necessary to protect those uses will be maintained. Compliance for permitting purposes is accomplished through a significance determination by the Department. A determination of nonsignificant changes in water quality is based on the criteria set forth in ARM 17.30.715 regarding flow volume, carcinogenic parameters, toxic parameters, nitrate and phosphorous concentrations, harmful parameters, and parameters for which there are only narrative water quality standards.

The applicable ground water quality standards and nondegradation significance criteria are included in Table 4.

Table 4. Applicable Water Quality Standards and Nondegradation Significance Criteria

Parameter	MDEQ Circular 7 Human Health Ground Water Standards	Nondegradation Significance Criteria in Ground Water for Level II Treatment
Nitrate (as N)	10 mg/L	7.5 mg/L
Total Phosphorus	no standard	50 year breakthrough [(1)], mg/L
E-Coli Bacteria	<1 organism per 100 ml	<1 organism per 100 ml

[1]The phosphorus significance criteria is listed in ARM 17.30.715(1)(e): "changes in concentration of total inorganic phosphorus in ground water if water quality protection practices approved by the department have been fully implemented and if an evaluation of the phosphorus adsorptive capacity of the soils in the area of the activity indicates that phosphorus will be removed for a period of 50 years prior to a discharge to any surface waters."

Concentration-based limits for nitrate (as N) in the ground water at the boundary of any applicable mixing zone are established according to levels of wastewater treatment [75-5-301(5)(d)(iii), MCA and ARM 17.30.702] (also, see Part III.B. of this statement of basis).

Shallow ground water samples collected from the seven onsite wells provided nitrate + nitrite (as N) concentrations ranging from non-detect (<0.05 mg/L) in Well #4, the hydraulically upgradient well, to 3.27 mg/L in Well #7 located approximately 500 feet hydraulically downgradient from the proposed Phase I drainfield area. Based on five samples collected from Well #7 over a period of three calendar-year quarters in 2007, the average ambient nitrate + nitrite (as N) concentration in the receiving ground water at the proposed FVEMS is 2.6 mg/L.

Table 5. Local Shallow Ground Water Characteristics

Parameter, units	Average Value	Minimum Value	Maximum Value	Number of Samples	Source of Data
Specific Conductance, µmhos/cm	522	485	570	5	Well #7
Total Dissolved Solids, mg/L	320	305	352	4	Well #7
pH, s.u.	7.85	7.7	8	4	Well #7
Chloride, mg/L	16.75	16	18	4	Well #7
Escherichia Coli, #/100ml	<1	<1	<1	4	Well #7
Nitrate + Nitrite, as N, mg/L	2.6	1.86	3.27	5	Well #7
Kjeldahl Nitrogen, as N, mg/L	<0.5	<0.5	<0.5	5	Well #7
Total Phosphorous, mg/L	0.03	0.02	0.05	5	Well #7
Total Organic Carbon, mg/L	1.78	1.2	5.9	4	Well #7

VI. Mixing Zone

A mixing zone, as defined in 75-5-103(18), "means an area established in a permit or final decision on nondegradation issued by the Department where water quality standards may be exceeded, subject to conditions that are imposed by the Department and that are consistent with the rules adopted by the Board." Requirements for granting a mixing zone are based on 75-5-301(4), MCA, which states that mixing zones must: (a) be the smallest practicable size, (b) have a minimum practicable effect on water uses, and (c) have definable boundaries. The Department has adopted rules implementing the nondegradation policy established in 75-5-303, MCA to provide that changes in nitrate (as N) in the ground water are nonsignificant if the discharge will not cause degradation of surface water and the predicted concentration of nitrate (as N) at the boundary of the ground water mixing zone does not exceed limits as specified in 75-5-301(5)(d), MCA.

The permittee must comply with the ground water mixing zone rules pursuant to ARM Title 17, Chapter 30, Subchapter 5. The Department shall assess the information received from the applicant concerning the biological, chemical, and physical characteristics of the receiving water as specified in ARM 17.30.506 or as requested by the Department. The Department will determine the applicability of a mixing zone, as well as the size, configuration, and location [see ARM 17.30.505(1)].

To qualify for a standard ground water mixing zone [ARM 17.30.517(1)(c)], the concentration(s) of the pollutants at the hydraulically downgradient boundary of the mixing zone discharge must meet the nonsignificance criteria, as specified in ARM 17.30.715.

The permittee has proposed to discharge all wastewater from Outfall 001 and 002 and has requested a standard 500-foot ground water mixing zone (ARM 17.30.517) for each outfall. The shape of each mixing zone is determined using the dimensions of that particular drainfield and information on water table elevations and topography.

The shallow ground water flow direction at this site is S62°E and the average hydraulic gradient is 0.0008 ft/ft (see Part IV.D of this statement of basis for details). The width of the drainfield, perpendicular to the direction of ground water flow is 670 feet for Outfall 001, and 428 feet for Outfall 002. Two separate, standard 500-foot ground water mixing zones (one per outfall) will be granted for an individual parameter of nitrate (as N). Mixing zones may be granted for individual parameters present in a discharge [ARM 17.30.505(1)(a)].

The average ambient nitrate + nitrite (as N) concentration in the receiving water of the shallow ground water at the proposed site is 2.6 mg/L (see Part V of this statement of basis). The concentration of pollutants has been estimated based on a mass balance calculations at the downgradient boundary of each of the two proposed standard 500-foot mixing zones [ARM 17.30.517(1)(d)] .

No mixing zone will be granted if it would threaten or impair existing beneficial uses [ARM 17.30.506(1)]. DEQ Circular 7 (February, 2006) human health-based ground water standards must not be exceeded beyond the boundaries of a mixing zone [ARM 17.30.1005(2) and ARM 17.30.508(1)(a)]. In addition, the zone of influence of any drinking water well will not be allowed to intercept a ground water mixing zone [ARM 17.30.508(2)].

VII. Proposed Discharge Limits and Conditions

A. Scope and Authority

The Montana Water Quality Act (Act) states that it is unlawful to discharge sewage, industrial waste or other wastes into any state water without a current permit from the Department (75-5-605(2), MCA). The Act also sets forth duties of the Department that shall include the following: issue, suspend, revoke, modify, or deny permits 401(1), MCA; examine information in order to issue a permit or issue a permit with conditions 401(2), MCA; and specify limitations in the permit 401(3), MCA. The Act also establishes that rules shall be adopted governing the application, authorization and issuance of permits to discharge sewage, industrial wastes or other wastes to state waters, provided the limitation of said permits will not result in pollution of any state waters.

B. Proposed Effluent Limits

ARM 17.30.1031 states that all issued MGWPCS permits must contain conditions including, but not limited to, discharge limitations, which will assure compliance with the ground water standards given due consideration to the economics of waste treatment and prevention. ARM 17.30.1005(1) states, the standards in ARM 17.30.1006 establish the maximum allowable changes in ground water quality and are the basis for limiting discharges to ground water.

1. Total Nitrogen

Data show recirculating sand filter (RSF) wastewater treatment systems produce a high quality effluent, and are considered to be a Level II treatment according to ARM 17.30.702(11). A Level II system must provide at least a 60 percent removal of total nitrogen (TN) in the raw wastewater or an effluent TN concentration of 24 mg/L or less beneath the drainfield [ARM 17.30.702(11)]. The Department has established that a properly installed, operated and maintained RSF wastewater treatment system meets the definition of a Level II system.

Based on the performance of the system, the technology-based effluent concentration limits (TBELs) for TN are set forth in Table 6 and Table 7. These limits are applicable to effluent samples collected at each dose tank prior to discharge to each outfall (i.e.,subsurface drainfield).

Table 6. Technology-Based Effluent Limits for Outfall 001

Parameter	Daily Maximum Concentration (1) mg/L per Outfall	90-Day Average Load(1)(pounds per day)
Total Nitrogen, as N (TN)(2)	26	3.17(3)
Total Phosphorus, as P (TP)	NA	1.29

(1) See definitions in Part V of this permit.
(2) Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).
(3) When the WQBEL concentration is greater than 26 mg/L TN, 26 mg/L is used in the calculation of the load limit.
NA Not Applicable

Table 7. Technology-Based Effluent Limits for Outfall 002

Parameter	Daily Maximum Concentration (1) mg/L per Outfall	90-Day Average Load(1)(pounds per day)
Total Nitrogen, as N (TN)(2)	26	1.99(3)
Total Phosphorus, as P (TP)	NA	1.29

(4) See definitions in Part V of this permit.
(5) Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).
(6) When the WQBEL concentration is greater than 26 mg/L TN, 26 mg/L is used in the calculation of the load limit.
NA Not Applicable

However, the effluent permit limit for TN will be set at a 60% removal rate, which is applicable to a Level II treatment system. For each outfall, the percent rate of TN removal is calculated from the difference between the raw sewage influent TN concentration and the effluent TN at the dose tank divided by the influent TN concentration multiplied by 100 (see Part IX. of this statement of basis). An additional 7% of nitrogen removal via natural treatment occurs within the drainfield (MDEQ, March, 2005), providing a final TN removal rate of 60% or greater discharged to ground water.

Alternate Technology-Based Effluent Limitation:

Percent (%) Removal

There must be at least a 60% removal of TN from the raw influent at Outfall 001 (see Part IX. of this statement of basis).

Alternate Technology-Based Effluent Limitation:

Percent (%) Removal

There must be at least a 60% removal of TN from the raw influent at Outfall 002 (see Part IX. of this statement of basis).

VIII. Water-Quality Based Effluent Limits

The Montana Water Quality Act states, it is unlawful to discharge sewage, industrial wastes, or other wastes into any state waters (75-5-605(1)(c), MCA). The Act requires that a discharge to state waters shall not cause a violation of water quality standards (75-5-605(1)(a), MCA). Water quality limitations must be established in permits (75-5-605(1)(b), MCA) to control all pollutants or pollutant parameters that are or may be discharged at a level which will cause, have reasonable potential to cause or contribute to an excursion above any state water quality standard. The permittee must comply with Montana Numeric Water Quality Standards set forth in MDEQ Circular 7 (February 2006) and the protection of beneficial uses (ARM 17.30.1006).

Permits are required to include water-quality based effluent limits (WQBEL) when technology-based effluent limits are not adequate to protect state water quality standards (40 CFR 122.44 and ARM 17.30.1344). Montana water quality standards (ARM 17.30.10 et seq.) define both ground water use classifications for all state waters and numeric and narrative standards that protect those designated uses. New sources, as defined in ARM 17.30.702(18), are subject to Montana Nondegradation Policy (75-5-303, MCA) and regulations (ARM 17.30.701 *et. seq*).

A. Nitrate

The proposed wastewater system constitutes a new source [ARM 17.30.702(18)]. The Class I ground water is considered high quality water and is subject to Montana's Nondegradation Policy (75-5-303, MCA). The applicable ground water standard is based on nondegradation, with a nitrate (as N) concentration limit of 7.5 mg/L [ARM 17.30.715(1)(d)(iii)] at the end of the proposed standard 500-foot ground water mixing zone.

The total nitrogen (TN) concentration is the sum of nitrate plus nitrite, as nitrogen (N) plus Total Kjeldahl Nitrogen (as N) [TKN]. TKN is the sum of ammonia and organic nitrogen components. Raw wastewater consists primarily of ammonia. Treatment in septic tanks and drainfield convert the ammonia to nitrite and nitrate, as N. Sand filters, trickling filters, and aerobic treatment units, as well as unsaturated zone material beneath the drainfields, convert the organic N (TKN) to nitrate, as N. The Department assumes all of the nitrogen discharged to the drainfield in the effluent has been converted to nitrate, as (N) [MDEQ, 2005]. The allowable discharge concentration is derived from the mass balance water quality equation [ARM 17.30.517(1)(d)], which considers dilution and the background concentration of the receiving water (EPA, 2000).

The allowable discharge concentration beneath the Phase I drainfield (Outfall 001) is:

$$C_2 = \frac{C_3 (Q_1 + Q_2) - C_1 Q_1}{Q_2}$$

C_2 = 36 mg/L

C_1 = ambient ground water (background) concentration, is 2.6 mg/L
C_2 = allowable discharge concentration (TN) beneath the drainfield in mg/L
C_3 = ground water concentration limit for pollutant (from DEQ Circular 7 or other appropriate water quality standard) at the end of the mixing zone is 7.5 mg/L, instantaneous (no single sample shall exceed)
Q_1 = ground water volume is 11,307.96 ft^3 / day
Q_2 = maximum flow of discharge (average daily flow of system is 1,951.87 ft^3 /day)

For the Phase I wastewater treatment system, the volume of ground water [ARM 17.30.517(1)(d)(i)] that will mix with the discharge (Q_1) is estimated using Darcy's equation: Q_1 = K I A. The calculated value of Q_1 is 11,307.96 ft^3/day for the mixing zone; assuming an aquifer K value of 1,244 ft/day based on onsite aquifer pump test data, an average hydraulic gradient of 0.0008 ft/ft measured using onsite SWL data, and a cross sectional area of flow at the downgradient boundary of the standard 500-foot mixing zone of 11,362.50 ft^2.

The average daily flow of the wastewater disposal system is 14,600 gpd or 1,951.87 ft^3/day. The nitrate (as N) concentration must not exceed 7.5 mg/L at the end of the mixing zone. The ambient concentration of nitrate-nitrogen in the alluvial ground water is 2.6 mg/l (C_1). It is assumed that the entire TN load in the effluent converts to nitrate (as N) and enters the ground water.

As discussed in Part VII.B.1., nitrate reduction of approximately 7 percent (MDEQ, March, 2005) is acknowledged to occur naturally beneath the drainfield. Therefore, to discharge a TN concentration of 36 mg/L below the drainfield, the effluent limit from the RSF system at the dose tank prior to discharge to the subsurface drainfields is calculated at 38.52 mg/L of TN.

36 mg/L (.07) = 2.52 mg/L	Nitrate reduction beneath the drainfield.
36 mg/L + 2.52 mg/L = 38.52 mg/L	Maximum concentration of TN at the dose tank, prior to discharge to the subsurface drainfield (Outfall 001).

The calculated effluent concentration of TN must not exceed 38.52 mg/L at the design average daily flow in order to maintain a concentration that is less than the state water quality standard of 7.5 mg/L for nitrate plus nitrite (as N) in the ground water at the mixing zone (Part VI) boundary. The WQBEL will be expressed as a load (lbs/day) [ARM 17.30.517(1)(d)(vi)(B)] based on the design flow of the system (14,600 gpd) and the calculated maximum concentration as follows:

Load limit (lbs/day) per outfall =effluent flow rate (gpd) x daily maximum concentration (mg/L) ***x*** *(8.34 x* 10^{-6}*)*

Load limit (lbs/day) per outfall= (14,600 gpd) **x** (38.52 mg/L) **x** (8.34 x 10^{-6})

Load limit (lbs/day) per outfall= 4.69 lbs/day

However, since the mass balance WQEL of 36 mg/L nitrate (as) is greater than the TBEL of 26 mg/L nitrate (as N) at the drainfield dose tank, the load limit will be calculated using the TBEL as follows:

Load limit (lbs/day) per outfall = (14,600 gpd) **x** (26 mg/L) **x** (8.34×10^{-6})
Load limit (lbs/day) per outfall = 3.17 lbs/day

The allowable discharge concentration beneath the Phase II drainfield is:

$$C_2 = \frac{C_3 (Q_1 + Q_2) - C_1 Q_1}{Q_2}$$

C_2 = 38 mg/L

C_1 = ambient ground water (background) concentration, is 2.6 mg/L
C_2 = allowable discharge concentration (TN) beneath the drainfield in mg/L
C_3 = ground water concentration limit for pollutant (from DEQ Circular 7 or other appropriate water quality standard) at the end of the mixing zone is 7.5 mg/L, instantaneous (no single sample shall exceed)
Q_1 = ground water volume is 7,695.38 ft^3 / day
Q_2 = maximum flow of discharge (design average daily flow of system is 1,229.95 ft^3 /day)

For the Phase II wastewater treatment system, the volume of ground water [ARM 17.30.517(1)(d)(i)] that will mix with the discharge (Q_1) is estimated using Darcy's equation: Q_1 = K I A. The calculated value of Q_1 is 7,695.38 ft^3/day for the mixing zone; assuming an aquifer K value of 1,244 ft/day based on onsite aquifer pump test data, an average hydraulic gradient of 0.0008 ft/ft measured using onsite SWL data, and a cross sectional area of flow at the downgradient boundary of the standard 500-foot mixing zone of 7,732.5 ft^2.

The design average daily flow of the wastewater disposal system is 9,200 gpd or 1,229.95 ft^3/day. The nitrate (as N) concentration must not exceed 7.5 mg/L at the end of the mixing zone. The ambient concentration of nitrate-nitrogen in the alluvial ground water is 2.6 mg/l (C_1). It is assumed that the entire TN load in the effluent converts to nitrate (as N) and enters the ground water.

As discussed in Part VII.B.1., nitrate reduction of approximately 7 percent (MDEQ, March, 2005) is acknowledged to occur naturally beneath the drainfield. Therefore, to discharge a TN concentration of 38 mg/L below the drainfield, the effluent limit from the RSF system at the dose tank prior to discharge to the subsurface drainfields is calculated at 40.66 mg/L of TN.

38 mg/L (.07) = 2.66 mg/L	Nitrate reduction beneath the drainfield.
38 mg/L + 2.66 mg/L = 40.66 mg/L	Maximum concentration of TN at the dose tank, prior to discharge to the subsurface drainfield (Outfall 002).

The calculated effluent concentration of TN must not exceed 40.66 mg/L at the design average daily flow in order to maintain a concentration that is less than the state water quality standard of 7.5 mg/L for nitrate plus nitrite (as N) in the ground water at the mixing zone (Part VI) boundary. The

WQBEL will be expressed as a load (lbs/day) [ARM 17.30.517(1)(d)(vi)(B)] based on the design flow of the system (9,200 gpd) and the calculated maximum concentration as follows:

Load limit (lbs/day) per outfall= effluent flow rate (gpd) x daily maximum concentration (mg/L) **x** *(8.34 x 10^{-6})*

Load limit (lbs/day) per outfall= (9,200 gpd) **x** (40.66 mg/L) **x** (8.34 x 10^{-6})

Load limit (lbs/day) per outfall= 3.12 lbs/day

However, since the mass balance WQEL of 40.66 mg/L nitrate (as) is greater than the TBEL of 26 mg/L nitrate (as N) at the drainfield dose tank, the load limit will be calculated using the TBEL as follows:

Load limit (lbs/day) per outfall = (9,200 gpd) **x** (26 mg/L) **x** (8.34 x 10^{-6})
Load limit (lbs/day) per outfall = 1.99 lbs/day

The WQBELs are summarized in Table 7 for Outfall 001 and in Table 8 for Outfall 002.

B. Phosphorus

A concentration of 10.6 mg/L of total phosphorous (TP) is consistent with the concentration found in residential wastewater. Therefore, the estimated load using the average daily flow rate for each outfall is 1.29 lbs/day from Outfall 001, and 0.81 lbs/day from Outfall 002.

More precisely, phosphorus is removed mainly through soil sorption processes, which are slow and vary based on soil composition. TP limitations are imposed to ensure that the quality of the effluent meets the nondegradation significance criteria prior to discharge into any surface water [ARM 17.30.715(1)(e)]. The effluent limits do not include a concentration limit for phosphorus because the method used to determine compliance is the 50-year breakthrough analysis. The 50-year breakthrough nondegradation criterion is based on the amount of soil available to adsorb the phosphorus between the discharge point and the surface water using the average load of phosphorus from the wastewater source.

Based on the ground water flow direction of S62°E at this site, a phosphorous breakthrough analysis shows the breakthrough time to the surface water (Silver Creek) for Outfall 001 is 355 years. The 50-year breakthrough for Outfall 002 is calculated to be 424 years. Therefore, the discharge is considered nonsignificant degradation pursuant to the criteria of ARM 17.30.715(1)(e).

C. E-Coli Bacteria

The Department is not granting a mixing zone for E-coli bacteria because a properly sited and operated drainfield should remove most, if not all, of the pathogenic bacterial indicators within 2 to 3 feet of the drainfield's infiltrative surface (USEPA, 2002). The E-coli water quality standard is <1 organism per 100 ml in the ground water (DEQ Circular 7, 2/2006). Based on the following site-specific criteria, ground water monitoring for E-coli bacteria at the hydraulically downgradient edge of the subsurface drainfields will not be required at this time.

- The depth to shallow ground water beneath the proposed drainfield areas ranges from 25 to 45 feet, providing sufficient separation in the unsaturated zone for natural treatment to occur.
- Drinking water wells are greater than 100 feet from the hydraulically downgradient boundary of the proposed standard 500-foot ground water mixing zone for each outfall.
- E-coli bacteria will be a quarterly monitoring/sampling requirement from each ground water monitoring well located at the end of each of the twp standard 500-foot ground water mixing zones.

The systematic pressure-dosing of the drainfields will minimize saturated conditions and maximize the die-off rate in the natural sediments. The proposed subsurface drainfields will discharge effluent approximately 2 to 4 feet below the ground surface. This should provide an adequate thickness (25 to 45 feet) of soil-subsoils in the unsaturated zone where treatment will occur naturally before discharging to the ground water.

In the event an E-coli bacteria concentration is detected above the water quality standard (less than 1 organism per 100 ml) in either of the ground water monitoring wells located at the hydraulically downgradient boundary of the mixing zone for each outfall, the exceedance shall be verified by timely (72-hour) re-sampling. A validated E-coli exceedance confirming the presence of E-coli bacteria in the ground water will require at least one additional monitoring well to be drilled. This well(s) must be drilled and completed at the hydraulically downgradient edge of the drainfield from which the bacterial release had occurred (i.e., the impacted ground water monitoring well). Disinfection may be required to be added to the wastewater treatment system.

D. BOD and TSS

BOD_5 and TSS are monitored for wastewater treatment system efficiency to ensure the effective removal of biological material and that the proper aerobic biological processes are being maintained. There are no numeric ground water quality standards for BOD and TSS, however according to ARM 17.30.1006(1)(b)(ii) the beneficial uses for a Class I ground water must be maintained. BOD and TSS are not subject to nondegradation unless they have a reasonable potential to affect a beneficial use based on the significance criteria for BOD and TSS, which are narrative [ARM 17.30.715 (1)(g) and DEQ Circular 7].

Table 7. Water Quality-Based Effluent Limits for Outfall 001 (at the dose tank prior to discharge to the subsurface drainfields)

Parameter	Daily Maximum[(1)] Concentration (mg/L)	90-Day Average Load[(1)] (pounds per day)
Total Nitrogen, as N [TN]	38.52	4.7
Total Phosphorus, as P [TP]	NA	1.29

(1) See definitions, Part V of the permit
NA Not Applicable

Table 8. Water Quality-Based Effluent Limits for Outfall 002 (at the dose tank prior to discharge to the subsurface drainfields)

Parameter	Daily Maximum[(1)] Concentration (mg/L)	90-Day Average Load[(1)] (pounds per day)
Total Nitrogen, as N [TN]	40.66	3.12
Total Phosphorus, as P [TP]	NA	0.81

(1) See definitions, Part V of the permit
NA Not Applicable

IX. Final Effluent Limits

The proposed effluent limitations for Outfall 001 and Outfall 002 are summarized in Table 9 and Table 10, respectively. These limits are based on the more restrictive of the technology and water quality based criteria discussed in previous sections.

Since the applicant has requested a permit limit based on a 60% TN removal rate rather than the technology-based concentration limit 24 mg/L TN [ARM 17.30.702(11)]. The final proposed effluent concentration-based limit for TN is water quality-based, relating to the expected performance of the RSF system (Level II treatment) and the subsurface drainfields with proper operation and maintenance. The mass-balance calculation establishes the maximum concentration of TN in the effluent that can be discharged beneath the drainfield at each outfall. The nitrate sensitivity calculation provides the concentration-based limit that ensures the concentration of nitrate (as N) in the ground water at the end of the standard 500-foot mixing zone will not exceed 7.5 mg/L [75-5-301(5)(d), MCA and ARM 17.30.715(1)(d)(iii)].

The 60% removal rate is proposed at Outfall 001 to ensure the system operates at the Level II requirement with an effluent concentration of TN, not to exceed 36 mg/L beneath the drainfield. This satisfies the nondegradation criteria [ARM 17.30.715(1)(d)(iii)], which requires the permittee not to exceed the limit of 7.5 mg/L nitrate (as N) at the hydraulically downgradient boundary of the standard 500-foot ground water mixing zone from each outfall.

The 60% removal rate is proposed at Outfall 002 to ensure the system operates at the Level II requirement with an effluent concentration of TN, not to exceed 38 mg/L beneath the drainfield, as required by nondegradation criteria [ARM 17.30.715(1)(d)(iii)] to meet the limit of 7.5 mg/L at the hydraulically downgradient boundary of the standard 500-foot ground water mixing zone.

The final proposed effluent load limit is proposed based on the average daily flow and the WQBEL concentration. The load limit for TN is based on complying with the nondegradation criteria of 7.5 mg/L of nitrate (as N) in ground water.

The effluent limit for TP is water quality-based as determined according to nondegradation significance criteria. The water quality-based effluent load limit considers the assimilative capacity of the soil system to estimate the maximum load of phosphorus discharged to the ground water without exceeding the 50-year breakthrough. The 90-day average load limit will provide protection for the surface and ground water.

The effluent limits in Table 9 apply to the treated effluent at the dose tank prior to discharge to the drainfield/Outfall 001 as shown in Attachment 1.

Table 9. Numeric Effluent Limits for Outfall 001

Parameter	**Daily Maximum Concentration [(1)] (mg/L) per Outfall**	**90-Day Average Load[(1)] (pounds per day) per Outfall**
Total Nitrogen, as N (TN)[(2)]	38.52	3.17
Total Phosphorus, as P (TP)	NA	1.29

(1) See definitions, Part V of the permit.
(2) Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).
NA Not Applicable

Other Discharge Limitations:

The average daily flow of effluent discharged to Outfall 001 shall not exceed 14,600 gpd.

There must be at least a 60% removal of TN from the raw influent. The percent (%) removal shall be calculated using the following equation:

$$\text{Percent removal} = \frac{\text{Influent Concentration} - \text{Effluent Concentration}}{\text{Influent Concentration}} \times 100$$

The effluent limits in Table 10 apply to the treated effluent at the dose tank prior to discharge to the drainfield/Outfall 002 as shown in Attachment 2.

Table 10. Numeric Effluent Limits for Outfall 002

Parameter	**Daily Maximum Concentration [(1)] (mg/L) per Outfall**	**90-Day Average Load[(1)] (pounds per day) per Outfall**
Total Nitrogen, as N (TN)[(2)]	40.66	1.99
Total Phosphorus, as P (TP)	NA	0.81

(1) See definitions, Part V of the permit.
(2) Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).
NA Not Applicable

Other Discharge Limitations:

The average daily flow of effluent discharged to Outfall 002 shall not exceed 9,200 gpd.

There must be at least a 60% removal of TN from the raw influent (see Part VI.A. of this statement of basis). The percent (%) removal shall be calculated using the following equation:

$$\text{Percent removal} = \frac{\text{Influent Concentration} - \text{Effluent Concentration}}{\text{Influent Concentration}} \times 100$$

X. Monitoring Requirements

A. Influent Monitoring

The permittee will be required to monitor the influent for the constituents in Table 11, at the frequency and with the type of measurement indicated in order to demonstrate that the Level II treatment system is achieving a 60 percent removal rate of TN [75-5-103(28), MCA and ARM 17.30.702(11)]. Samples or measurements shall be representative of the volume and nature of the raw sewage waste stream. Influent sampling/monitoring for Outfall 001 shall be conducted by collecting a sample of the raw influent from the first (arranged in series) 25,000-gallon central septic tank prior to entering the recirculation tank and the RSF (see Attachment 1). Influent sampling/monitoring for Outfall 002 shall be conducted by collecting a sample of raw influent from the first (arranged in series) 12,000-gallon central septic tank prior to entering the recirculation tank and the RSF (see Attachment 2).

Table 11. Influent Monitoring Parameters

Parameter, units	Frequency	Sample Type[(1)]
Nitrate + Nitrite (as N), mg/L	Quarterly	Composite
Total Kjeldahl Nitrogen (as N), mg/L	Quarterly	Composite
Total Nitrogen, as N (TN), mg/L	Quarterly	Calculated[(2)]

(1) See definitions, Part V of the permit.
(2) Total Nitrogen (as N) TN = (nitrate + nitrite, as N) + total Kjeldahl Nitrogen (TKN)

B. Effluent Monitoring

Effluent monitoring is essential to ensure the effective treatment and consistency of the wastewater discharged from the facility. The effluent limits are established to protect the ground water from a change in water quality that would cause degradation [ARM 17.30.715] or cause a change in beneficial use [ARM 17.30.1005(1)]. Samples or measurements shall be representative of the volume and nature of the monitored discharge at each outfall, separately.

The Department shall require effluent sampling using specified monitoring methods at designated locations and intervals (75-5-602(4), MCA). Effluent monitoring/sampling shall be conducted by collecting a separate composite sample from each of the wastewater treatment systems' dose tank that is representative of the discharge prior to discharging to the subsurface drainfields (Outfall 001 and Outfall 002). Individual composite samples collected from each dose tank, separately shall be submitted to the laboratory for analyses of all of the parameters in Table 12.

The permittee shall monitor the effluent to be discharged at Outfall 001 and Outfall 002 (separate samples) for the parameters in Table 12. These samples shall be collected at the frequency and with the type of measurement and sampling as indicated in Table 12 [ARM 17.30.1031(5)]. It is the responsibility of the permittee to establish and maintain records of all monitoring (75-5-602(1), MCA), and make reports (DMRs) of the required data to the Department (75-5-602(2), MCA). If no discharge occurs during the entire monitoring period, it shall be stated in a Discharge Monitoring Report (DMR) that "no discharge" occurred.

TABLE 12. Parameters To Be Monitored in the Effluent at Outfall 001 and Outfall 002, separately (at each dose tank)

Parameter, units	Frequency	Sample Type[1]
Effluent Flow Rate, gpd[2]	Continuous	Continuous[1]
Total Suspended Solids,(TSS), mg/L	Quarterly	Composite
Biological Oxygen Demand (BOD_5), mg/L	Quarterly	Composite
Total Kjeldahl Nitrogen, as N (TKN), mg/L	Quarterly	Composite
NO_3+NO_2 (as N), mg/L	Quarterly	Composite
Total Phosphorus, as P(TP), mg/L	Quarterly	Composite
Total Nitrogen, as N (TN), mg/L	Quarterly	Calculated[3]
Total Nitrogen, as N (TN), lb/d	Quarterly	Calculated[4]
Total Phosphorus, as P (TP), lb/d	Quarterly	Calculated[4]

(1) See definitions, Part V of the permit
(2) To be measured by a totalizing flow meter at the dose vault
(3) Total Nitrogen, as N = nitrate + nitrite, (as N) + total Kjeldahl nitrogen, (as N)
(4) See definition of "quarterly average" in Part V of the permit.

The 90-day average load for TN and TP are the sum of the calculated loads for each TN and TP sample collected within the 90-day period, divided by the number of samples collected and analyzed for TN and TP.

The permittee shall install, use, and maintain monitoring equipment or methods (75-5-602(3), MCA). The effluent measurement method shall be either by recorder or totalizing flow meter. Dose counts or pump run-times will not be accepted for new wastewater systems. The permittee shall monitor the flow of the effluent for Outfall 001 at the meter located following the 4,500-gallon dose tank prior to entering the subsurface drainfield (see Attachment 1). The permittee has stated in the permit application that the method of flow monitoring will be three (3) Orenco FM200 totalizing turbine flow meters. The permittee shall report the flows for Outfall 001 based on the average gallons per day (gpd) for each quarter.

The permittee shall monitor the flow of the effluent for Outfall 002 at the meter located following the 4,000-gallon dose tank prior to entering the subsurface drainfield (see Attachment 2). The permittee has stated in the permit application that the method of flow monitoring will be two (2) Orenco FM200 totalizing turbine flow meters. The permittee shall report the flows for Outfall 002 based on the average gallons per day (gpd) for each quarter.

C. Ground Water Monitoring

ARM 17.30.505(1)(e) states, "estimated parameter levels in the mixing zone area will be calculated, unless the Department determines that monitoring is necessary due to the potential harm to the impacted water and its beneficial uses." To ensure compliance with applicable water quality standards and beneficial uses at the end of the standard 500-foot ground water mixing zones, monitoring may be required [ARM 17.30.517(1)(d)(ix)].

In addition, ARM 17.30.706(6) specifies that in order to ensure that a proposed activity will not result in degradation, the Department may require monitoring to verify compliance with this subchapter and 75-5-303, MCA.

Ground water monitoring will be required in this permit due to the following site-specific criteria:

- The descriptions of the soils and subsoils (8 feet bgs) in this area consist of loamy sand with greater than 75% gravel (see test pit soil descriptions in Part IV.A. of this statement of basis) and indicate the potential for rapid infiltration.
- The depth to shallow ground water beneath the proposed drainfield areas ranges from approximately 25 to 45 feet beneath the drainfields and consists of Quaternary alluvium essentially composed of sand and gravel.
- Rapid hydraulic conductivities (K) in the shallow aquifer from onsite aquifer pump test data, as well as Ks provided from adjacent subdivisions in this area of the Helena Valley suggest rapid transmission of potential contaminants in the ground water.
- At least one shallow drinking water-supply well (Hahn) is within 500 feet of the hydraulically downgradient boundaries of the two proposed standard 500-foot ground water mixing zones.
- Although the Hahn well is over 100 feet from the downgradient mixing zone boundaries [ARM 17.30.508(2)], it would be the first receptor for any potential impacts from the drainfields/outfalls, if the two ground water monitoring wells were not required.
- Two shallow USGS (Research and Observation) wells are located hydraulically downgradient from the southeast boundary of the ground water mixing zone for the Phase II drainfield/outfall and outside the property boundary, in Section 30, T11N, R3W. These wells are within 500 feet from the mixing zone boundary, but within a potential contaminant plume pathway, particularly if diffusion is considered.

The permittee is required to monitor the ground water quality at the hydraulically downgradient boundary of the proposed standard 500-foot ground water mixing zone for Outfall 001. The location of the monitoring well (MW1) is 500 feet in a S62°E direction from the midpoint of the proposed Phase I subsurface drainfield/Outfall 001. Specifically, MW1 has been located on the east side of Frontier Drive at the southwest corner boundary of Lot 99 and the northwest corner boundary of Lot 98. This well (MW1) will serve as a monitoring point for the standard 500-foot ground water mixing zone for Outfall 001.

Within no less than six (6) months prior to the activation of the Phase II wastewater treatment system (i.e., Outfall 002), the permittee is required to notify the Department that the system is being constructed and provide a final date when the wastewater treatment system will become operable. Six (6)months (i.e., two sample quarters) prior to operation, the permittee is required to monitor the ground water quality at the hydraulically downgradient boundary of the proposed standard 500-foot ground water mixing zone for Outfall 002 by installing a shallow ground water monitoring well. The location of the monitoring well (MW2) shall be 500 feet in a S62°E direction from the midpoint of the Phase II subsurface drainfield/Outfall 002. Specifically, MW2 shall be located on the east side of Frontier Drive in the northwest corner of Lot 111. This well (MW2) will serve as a monitoring point for the standard 500-foot ground water mixing zone for Outfall 002.

MW1 was drilled to a total depth of 56 feet. This monitoring well is completed with 4-inch diameter PVC pipe. A twenty-foot section of 0.010-slotted PVC screen extends from 36 to 56 feet below the TOC. MW1 shall be drilled and completed in the same manner as MW1. This means that MW2 shall be screened in the first shallow aquifer approximately from the top of the high ground water table to15 feet below the low water table. Any deviations from the monitoring well locations and

completion requirements must be approved by the Department prior to well installation or potential well replacement.

Ground water monitoring wells must be installed by a licensed monitoring well driller, according to monitoring well construction standards in ARM Title 30, Chapter 21, Subchapter 8. MW1 and MW2 must be constructed and secured according to ARM 17.50.707. A copy of the completed driller's logs must be submitted to the Department no later than 60 days from the date the well(s) are drilled and completed. The parameters to be monitored and the sampling frequency for monitoring well MW1 and MW2 are given in Table 13. These wells are to be sampled separately and analyses performed on each set of ground water monitoring well samples separately.

Table 13. Ground Water Monitoring Parameters for Monitoring Wells MW1 and MW2, (Samples to be Collected and Analyzed from each Well Separately)

Parameter, units	Frequency	Sample Type[(1)]
Static Water Level (SWL), feet below top of casing	Quarterly	Measured
Nitrate + Nitrite (as N), mg/L	Quarterly	Grab
Nitrate as N, mg/L	Quarterly	Grab
Total Kjeldahl Nitrogen (TKN), mg/L	Quarterly	Grab
Chloride, mg/L	Quarterly	Grab
E-Coli Bacteria, organisms/100 ml	Quarterly	Grab
Specific Conductance, umhos/cm	Quarterly	Grab
Total Phosphorous (TP), mg/L	Quarterly	Grab
Total Nitrogen, as N (TN) mg/L	Quarterly	Calculated

(1) See definitions, Part V. of the permit.

The monitoring of chloride and specific conductance is used as indicators of potential impacts from the wastewater to the ground water.

Ground water sample collection, preservation and analysis shall be conducted according to ARM 17.30.1007 and "Non-Point Source Water Quality Standard Operating Procedures" (4/1/95) at www.deq.mt.gov/wqinfo/monitoring/SOP/pdf/11-10.pdf , until the permit is issued. No later than 60 days from the date of permit issuance, the permittee shall develop and maintain onsite a site specific Standard Operating Procedure (SOP) manual and a Sampling and Analysis Plan (SAP) for monitoring and sampling the ground water monitoring well(s).

D. Corrective Action – Ground Water Trigger Values

The trigger values for ground water monitoring wells MW1 and MW2 are listed in Table 14. An exceedance of a trigger value for either E-coli bacteria or nitrate (as N) will require a resample be collected from the potentially impacted monitoring well(s) within 72 hours of the laboratory notification of the analytical results from the scheduled sampling event. Corrective action will need to be implemented should the analytical results from the re-sample verify the exceedance(s).

Table 14. Ground Water Trigger Values for Monitoring Well MW1 and MW2, separately

Parameter, units	Trigger Value
E-Coli Bacteria, organisms/100 ml	Equal to or greater than 1
Nitrate (as N), mg/L	7.5

An exceedance of the trigger value for E-coli bacteria in MW1 and/or MW2 will require a resample be collected from the monitoring well(s) within 72 hours of the laboratory notification of the analytical results from the scheduled sampling event. Corrective action will need to be implemented should the analytical result(s) from the resample verify the exceedance.

Ground water corrective action could involve but not be limited to, one or more of the following measures based on the nature and extent of the potential impacts to the ground water quality.

- Identification of the probable cause and extent of the ground water quality changes.
- Installation of additional ground water monitoring wells, including an upgradient well.
- Increased sampling (frequency and/or constituents).
- Increase the efficiency of the wastewater treatment system.
- Reduce the amount of nutrients or other parameters discharged into the ground water.
- Addition of disinfection to the effluent prior to discharge, if E-coli bacteria trigger value was exceeded.
- Supply drinking water to hydraulically downgradient residences.

XI. Nondegradation Significance Determination

The Department has determined that this discharge constitutes a new or increased source and there will be no degradation of state waters for the purpose of the Montana Nondegradation Policy [75-5-303, MCA; ARM 17.30.702(18)]. The applicable water quality standards for Class I ground water are summarized in Table 4. The effluent limits for TN and TP are based on compliance with water quality standards. The proposed discharge will not exceed the water quality standard for nitrate (as N) of 7.5 mg/L at the hydraulically downgradient boundary of the standard 500-foot ground water mixing zones for Outfall 001 and Outfall 002.

XII. INFORMATION SOURCES

In the development of the effluent limitations, monitoring requirements and special conditions for the draft permit, the following information sources were used to establish the basis of the draft permit and are hereby referenced:

ARM Title 17, Chapter 30, Sub-chapter 5 - Mixing Zones in Surface and Ground Water, September 1999.

ARM Title 17, Chapter 30, Sub-chapter 7 - Nondegradation of Water Quality, March 2000.

ARM Title 17, Chapter 30, Sub-chapter 10 - Montana Ground Water Pollution Control System (MGWPCS), March 2002.

Briar and Madison, "Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana", 1992, U.S.G.S., Water Resources Investigation Report 92-4023.

Cherry, J.A. and Freeze, R. A., *Groundwater*, Prentice-Hall Inc., Englewood Cliffs, NJ, 1979. Chapter 2, pages 26-29.

Fetter, C.W., *Applied Hydrogeology (Fourth Edition)*, Prentice Hall Inc., Englewood Cliffs, NJ, 2001.

Fladland SIT, Jason, Test Pit Logs and Data, August 14, 2006.

GWIC Database, http://mbmggwic.mtech.edu

MDEQ Circular 4, 2004.

MDEQ Circular 7 – Montana Numeric Water Quality Standards, February 2006.

MDEQ, Memo-Regensberger, "Revised Modification of Phosphorous Concentration for Domestic Sewage in Nondegradation Reviews," October 29, 1998.

MDEQ, "Nitrate Sensitivity Analysis Input Data", 1994.

MDEQ, "Non-Point Source Water Quality Standard Operating Procedures" (4/1/95) at www.deq.state.mt.us/wqinfo/monitoring/SOP/Sap.asp

MDEQ Statement of Basis for:
Applegate Meadows MGWPCS Permit No. MTX000176
Valleyview Subdivision MGWPCS Permit No. MTX000167

MDEQ, "How to Perform a Nondegradation Analysis for Subsurface Wastewater Treatment Systems (SWTS)," March 2005.

Montana SUURGO Soils/NRI, GWIC, 10/15/07.

USDA NRCS Soil Survey for Lewis and Clark County Area, January 1, 2003.

U.S. Environmental Protection Agency, Rev September 2000. U.S. EPA NPDES Permit Writers' Course, Helena, Montana, September, 2000, Workbook EPA 833-B-97-001.

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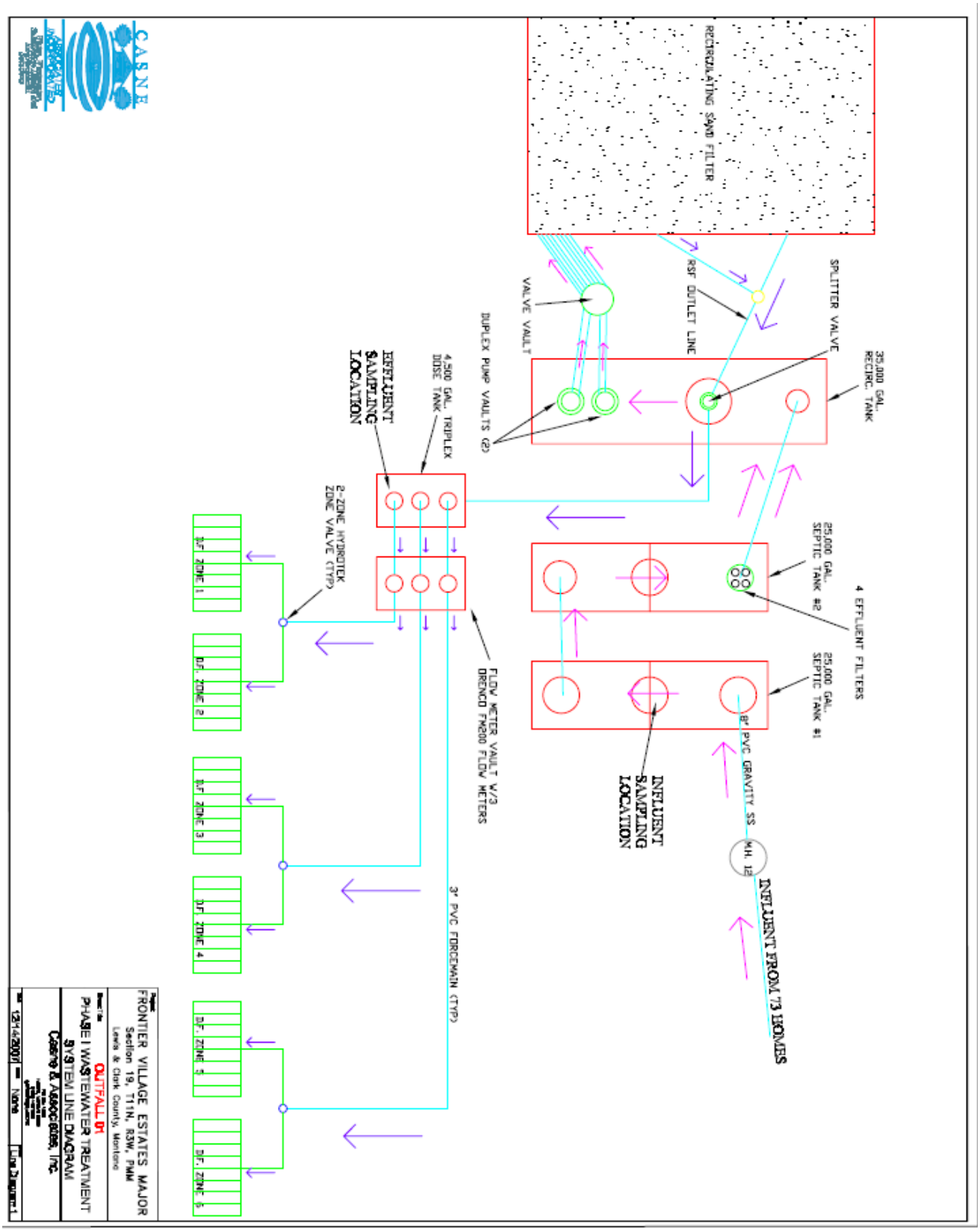
U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), "Mapunit Descriptions for the Lewis and Clark County Area, Montana", 1/27/03.

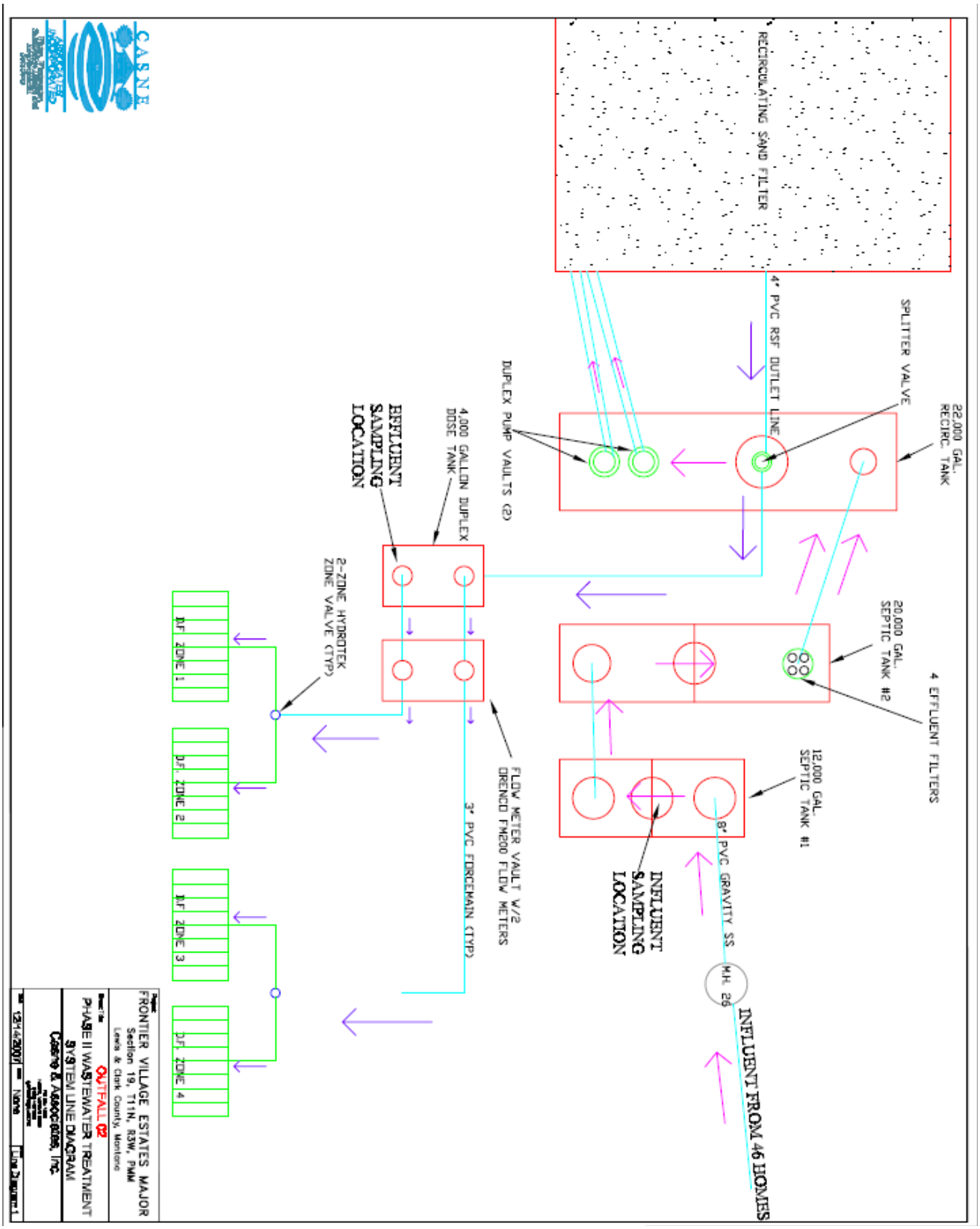
XIII. ATTACHMENTS

Attachment 1 – Phase I Wastewater Flow Line-Diagram
Attachment 2 – Phase II Wastewater Flow Line-Diagram

Prepared by: Pat Potts **Date:** March 24, 2008



ATTACHMENT 1



ATTACHMENT 2